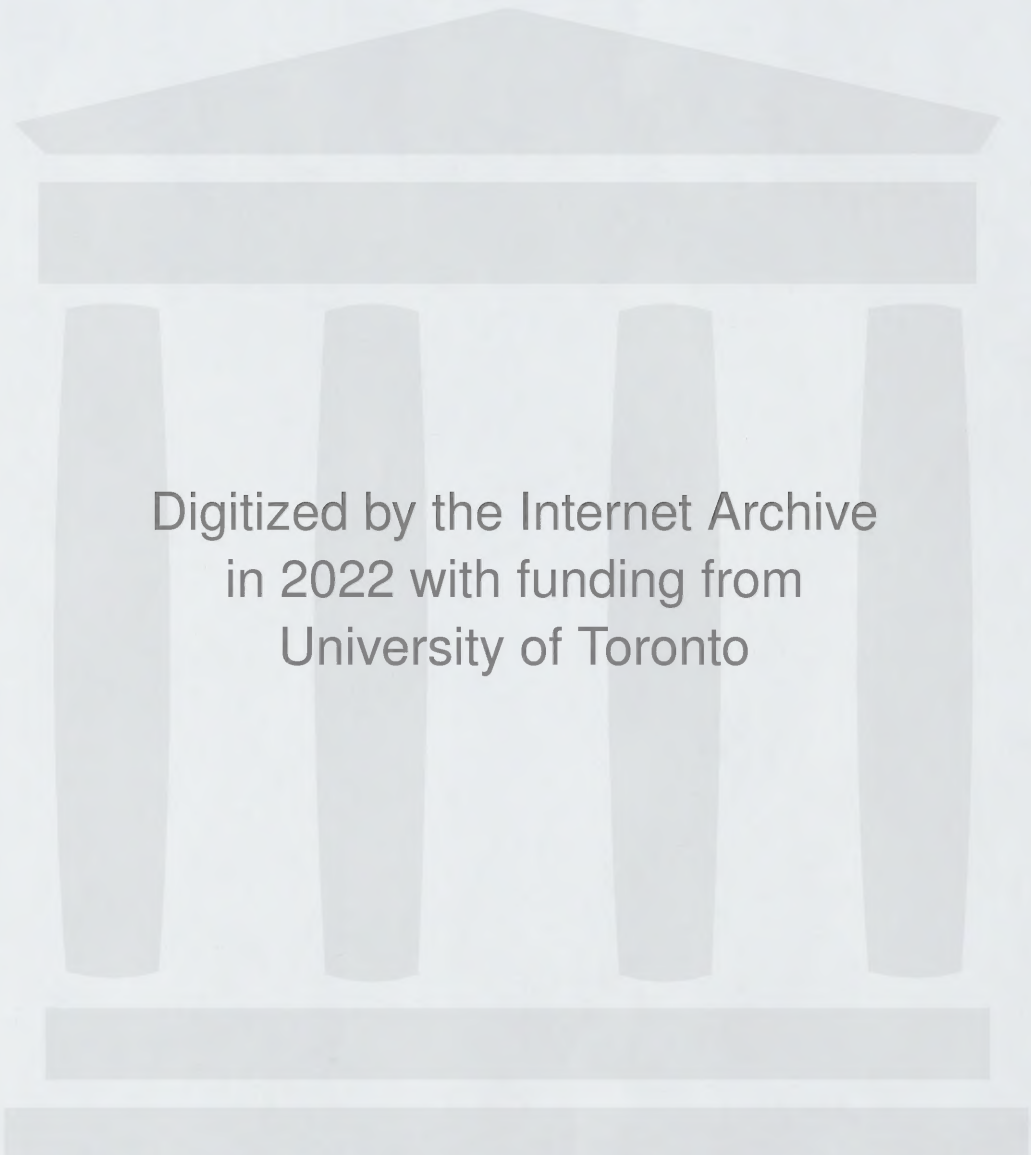
THE
HUDSON BAY RAILWAY BELT
AND HUDSON BAY

Prepared by
The Natural Resources Intelligence Service
Department of the Interior
Ottawa, Canada
1926



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W. T. Jackman.

------ PREFACE ------

The purpose of this memorandum is to give a brief synopsis of all information previously published concerning the resources of that portion of the country lying adjacent to Hudson Bay and the Hudson Bay railway in particular.

It has been compiled mainly from reports of exploratory parties and from data contained in federal and provincial government publications. In a few instances information has been procured from unofficial sources and its accuracy cannot be guaranteed.

A short chapter on navigation has of necessity been included on account of the proposed use of this route for grain shipments to Europe. A certain amount of investigation as to the navigable season in Hudson straits has been done and the results presented and published at various times. Many of these reports have been contradictory and controversial in character. No attempt has been made in this report, which is essentially a compilation, to do more than quote the testimony already presented and published.

Inquiries for further information will receive attention if addressed to the Commissioner of Northern Manitoba, The Pas, Manitoba, or to the Natural Resources Intelligence Service, Department of the Interior, Ottawa, which maintains an intelligent service available to the public.

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HUDSON BAY RAILWAY BELT AND HUDSON BAY

Physical Features

The district adjacent to the partially constructed Hudson Bay railway lies almost altogether in Manitoba and is roughly bounded on the southwest by the Pasquia hills, on the northeast by Hudson bay and on the southeast and northwest by the Hayes and Churchill rivers respectively. This represents an area about 160 miles wide and 450 miles long, some 70,000 square miles in extent.

The district is drained by three rivers flowing northeast to Hudson bay by parallel routes and traversing regions similar in type. The Nelson river is the central and largest of these, the other two being the Hayes and the Churchill, as previously mentioned. The Saskatchewan, another large stream indirectly feeding the Nelson via lake Winnipeg, flows east across the southern limits of the belt between the Pasquia hills and the Nelson height of land.

The whole region is in low relief the hills being seldom more than 200 feet high and the central slopes being 400 and 500 feet above sea level. The highest point along the railway is Elevation 962', at a point 60 miles northeast of The Pas. Much of the country between the Nelson and the Churchill rivers is of very gentle gradient, both locally and as a whole. Geologically the district is arranged in three general belts crossing the rivers at right angles of which the middle and most widespread division is part of the great Laurentian plateau, here 250 miles wide (as measured along the railway) with Pre-Cambrian crystalline rocks deeply covered by clay soils. South of it is a tract about 60 miles in width lying on flat limestone formation (Ordovician) thinly covered or bare of soil and draining southward to the Saskatchewan river. The Saskatchewan valley is confined towards the south by a series of escarpments, of which the Porcupine mountains, Pasquia and Wapawekka hills form the prominent features, and which constitute the northern boundary of the Great Plains region in this vicinity. Between the Laurentian and the Ordovician are outcrops of Huronian and Keewatin rocks, which are a mineral bearing series. North of the Laurentian, for 125 miles inland from Hudson bay, is the third geological belt consisting also of limestone formations (Ordovician with overlap of Silurian) with a wet clay and gravel subsoil and surfaced with mosses and frozen bog. It is believed that much of this district, sometimes known as the Arch-Hudsonian swamp, was previously occupied by sea waters which have now receded and are still receding slowly. The shores of Hudson bay on both sides of the Churchill are low and of such flatness that the tides cover them in places for several miles inland.

The interior drainage system apart from the largest rivers is very primitive and but a slight modification of conditions following the glacial period. The principal water highways have cut through the clay to bed rock very thoroughly in places, but on the whole local drainage is superficial and restricted in effect. Gradient everywhere appear sufficient to provide for surface run-off, but nature has not yet developed large enough channels, or a sufficient number, to carry away the ordinary rainfall and melted snows. There are a great number of lakes of all sizes; some 15 to 20% of the whole area is water surface. Even the river systems consist substantially of lake expansions spilling over from one to another. The following examples indicate in part the

size and prevalence of the fresh water bodies: Nelson Watershed - Lake Winnipeg (9,400 sq. mi.), Playgreen lake (223 sq. mi.), Reed (86 sq. mi.), Setting (58 sq. mi.), Wekuski (83 sq. mi.); Saskatchewan Watershed - Cumberland lake (160 sq. mi.), Cedar (285 sq. mi.), Moose (552 sq. mi.), Amisk (111 sq. mi.), Cormorant (141 sq. mi.), Atikameg (90 sq. mi.); Churchill Watershed - South Indian lake (1531 sq. mi.), North Indian (184 sq. mi.), Kississing (100 sq. mi.); Hayes Watershed - God's lake (319 sq. mi.), Island (551 sq. mi,).

The four rivers mentioned are important streams from many standpoints and represent the drainage of immense territories: Nelson drainage (including Saskatchewan River drainage), 370,800 square miles; Churchill drainage, 115,500 square miles; Hayes drainage, 28,000 square miles; Saskatchewan drainage, 158,800 square miles. Among the smaller rivers are: tributary to the Nelson river - Minago, Grass, Burntwood; to the Saskatchewan river - Carrot, Pascuia and Sturgeon-Weir; to the Churchill river - Reindeer, Little Churchill, Deer and Kississing; to the Hayes river - Trout, Wolfe, Fox, and Shamattawa rivers. The belt is accessible by these canoe routes and by trails from the railway itself. The Hayes river, which is navigable for 140 miles from its mouth at high water, has long been a favourite avenue for travel and transport between Hudson bay and lake Winnipeg, while the Nelson is unobstructed for 60 miles from lake Winnipeg and for about the same distance from its estuary. The Saskatchewan is used by steamers between Cumberland, Cedar and Moose lakes, being employed for all east and west traffic. The Churchill river in Manitoba is little travelled. The Railway is completed for 332 miles to its second crossing of the Nelson river at Kettle rapids where a bridge has been built.

HUDSON BAY

Hudson bay into which the waters of these rivers flow is a great inland sea 900 miles north and south and 500 to 600 miles east and west extending deeply into Manitoba, Ontario and Quebec from the North. It is connected with the Arctic ocean by Fox channel and the Gulf of Bothnia and with the Atlantic ocean by Hudson strait, a passage 500 miles long and from 45 to 100 miles wide, with deep water, few islands and pronounced shore lines furnishing good harbours on both sides. Due largely to the actions of the tides which in places are very high, 30 to 40 feet, and very strong, 6 to 7 miles per hour, the strait never freezes over but is the scene of many ice collections which come from down through Fox channel and to a lesser extent from Baffin's bay. The west shore south of Churchill and for 150 miles north is low, flat and without harbours; 200 miles north the coast becomes more rugged with inlets, harbours and islands. The east coast is irregular and bold with numerous islands and reefs. Pre-Cambrian rocks, largely granite and granite-gneisses, form both west and east coasts while the south shore from Churchill to James bay is made up of Palaeozoic limestones with Pre-Cambrian rocks further inland.

James bay, the southern extension, is 250 miles long, 120 miles wide and about 30,000 square miles in area. It is shallow for the most part, but deep water may be found well out from the west shore.

Many of the islands of Hudson bay are large and possess latent mineral and other resources. Amongst the more important are Southampton (19,000 sq. mi.), Bell, Coats, Marble, Mansfield, Akimiski, Charlton and Long islands and the Ottawa, Sleeper, King George, Bakers, Nastapoka and Belcher groups.

CLIMATE

Except for the summer months the climate of Northern Manitoba and adjacent districts of Ontario is several degrees colder than the northern agricultural belt of Saskatchewan and Alberta. Nevertheless it is by no means disagreeable. The daily hours of summer sunshine are long (about 18), and the low absolute altitude is favorable to early maturity of field crops. The winters are severe but exhilerating. Precipitation averages about 17 inches of which one-third falls as snow. The maximum distribution is in mid-year with a tendency for the wet season to extend through September.

In the tables of normal maximum and minimum temperatures given herewith, the average of eleven north-country stations are presented and compared with the averages from Edmonton, Battleford, Prince Albert and Melfort.

Table Showing
Mean Daily Maximum Temperatures
H.B. North Country.

Station	Jan.	Feb.	mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Cochrane	11	13	27	45	58	71	76	70	60	47	31	16
Hornepayne	8	12	23	43	55	71	72	72	67	50	30	15
Kapuskasing	10	12	24	44	57	72	73	70	62	46	30	16
Paqwa	11	15	26	47	61	73	74	71	63	46	29	17
Fort Hope	2	8	22	40	55	69	73	68	59	43	27	14
Trout Lake	-1	2	18	38	50	66	71	66	56	42	24	12
Moose Factory	8	10	24	39	53	67	74	69	62	47	29	15
York Factory	-11	-6	11	32	43	59	67	54	53	35	18	3
Norway House	2	5	21	42	57	66	72	68	57	42	24	7
Le Pas	3	6	24	43	59	70	76	72	60	50	26	12
Cumberland H.	4	7	20	43	61	72	74	72	62	47	22	10
Average for North Country	4	8	22	41	55	69	73	68	60	45	26	12
Northern Strip of Agricultural Operations in Saskatchewan and Alberta												
Edmonton	16	21	35	53	64	70	74	72	63	53	33	25
Battleford	6	10	26	50	62	70	76	74	64	52	29	16
Prince Albert	5	11	26	49	63	71	74	72	62	49	27	15
Melfort	7	10	24	46	62	69	74	72	62	50	28	16
General Average	8	13	28	49	63	70	74	72	63	51	29	18

Mean Daily Minimum Temperatures
H.B. North Country

Cochrane	-10	-10	2	22	35	45	50	48	41	31	17	-1
Hornepayne	-14	-16	-2	21	41	45	49	48	44	31	13	-7
Kapuskasing	-16	-14	-8	17	38	43	50	47	39	28	12	-4
Paqwa	-15	-10	-5	19	41	44	50	49	40	29	15	-3
Fort Hope	-20	-17	-6	16	37	45	51	47	39	27	12	-8
Trout Lake	-23	-23	-11	13	33	42	49	45	36	25	9	-10
Moose Factory	-17	-19	-5	16	32	42	50	48	41	31	15	-4
York Factory	-26	-22	-12	11	27	38	44	43	35	22	3	-17
Norway House	-21	-17	-4	19	34	45	53	50	41	29	10	-10
Le Pas	-18	-16	-7	18	33	44	51	48	39	27	8	-9
Cumberland H.	-16	-16	-6	19	35	46	50	47	38	26	7	-5
General Av. for North Country	-18	-16	-6	17	35	44	50	47	39	28	11	-7

Northern Strip of Agricultural Operations in Alberta and Saskatchewan.

Stations	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Edmonton	-4	zero	12	29	39	44	49	46	38	30	16	7
Battleford	-13	-12	4	26	36	46	50	46	39	28	11	-4
Prince Albert	-17	-14	-2	24	35	45	50	46	37	27	10	-5
Melfort	-12	-14	-4	22	34	44	50	46	35	26	8	-6
General Average	-12	-10	2	25	36	45	50	46	37	28	11	-2

Lowest Temperatures Recorded

Pagwa, Ont.												
1920	-48	-38	-33	5	18	30	32	29	25	14	-14	-34
1921	-33	-39	-20	0	21	26	26	35	29	14	-16	-32
1922	-36	-38	-15	6	28	29	27	28	24	zero	-13	-41
Kapuskusing												
1920	-52	-38	-39	2	20	33	34	27	22	10	-11	-31
1921	-37	-44	-30	-7	15	20	31	25	24	8	-28	-33
1922	-40	-41	-15	8	25	24	32	29	25	4	-15	-42
Cochrane, Ont.												
1920	-39	-25	-28	4	22	35	35	34	31	12	-7	-27
1921	-31	-29	-17	1	23	31	41	36	33	20	-10	-29
1922	-34	-38	-11	8	29	30	37	35	29	10	-4	-32
Moose Factory												
1920	-54	-32	-35	4	20	32	36	34	25	10	-6	-34
1921	-36	-42	-25	-10	23	observations missing					-15	-32
1922	-38	-40	obs.mis.		27	30	35	29	27	2	-11	-35
Le Pas												
1920	observations of doubtful value											
1921	observations of doubtful value.											
1922	-49	-44	-28	2	27	31	33	40	25	10	-12	-30
Norway House												
1920	-49	-41	-32	-23	25	25	37	42	28	20	0	-37
1921	-38	-29	-36	-10	18	36	45	34	29	25	-31	-32
1922	-45	-43	-36	mis.	22	41	44	mis.	30	1	-17	-34

Average Total Precipitation (Rain & Melted Snow)

Norway House	0.7	0.7	1.0	0.7	1.3	2.2	2.4	2.6	2.8	0.8	1.1	0.8
York Factory	1.1	0.5	1.1	1.2	1.0	1.6	2.2	3.2	2.3	1.4	0.9	1.5
Le Pas	0.7	0.6	0.5	0.8	1.6	2.2	2.3	2.3	1.6	1.2	1.0	0.5
Cochrane	1.9	1.1	1.4	1.4	2.7	2.4	3.5	3.4	2.9	2.8	2.3	1.5
Fort Hope	0.9	0.5	0.8	0.3	1.4	2.4	2.3	2.0	2.2	1.2	1.0	0.9
Moose Factory	1.1	0.6	1.4	0.9	2.2	2.6	3.1	3.2	3.2	1.8	1.9	1.5

Average Snowfall

Norway House	7	7	10	5	3	x	x		1	2	10	8
Moose Factory	11	6	13	5	4				x	4	12	14
Cochrane	18	11	12	6	?	x			1	3	12	14
Le Pas	7	6	4	4	2				x	4	9	5

x Snowfall less than $\frac{1}{2}$ inch.

Agriculture

Some settlement has been made in the Saskatchewan valley and along the routes of travel but it cannot be said that the agricultural future of the country has been accurately determined as yet, despite the fact that success has been met in a small way. At the same time prospects are by no means discouraging. The extent of arable soils is known to be considerable; rainfall is sufficient and well timed; and summer temperatures as recorded at The Pas and Norway House are exceedingly favourable to fast growth and early maturity of field crops. As far north as Split lake the natural flora of the well drained areas is practically identical with that of similar ground in the Riding mountains 400 miles southwest from Split lake. Some indication of the relative surface conditions prevailing in the belt may be obtained by examining a cross section of the country from The Pas northeast towards Nelson for approximately 350 miles as represented by an examination of lands adjoining the railway.

Type	Total Mileage	Percentage
Swamp soils	185	53
Boulder clay	27	8
Lake clay	105	30
Beach sand	3½	1
Bedrock outcrop	28	8
Total	348½	100

Soil surveys of this latent agricultural belt have not been attempted except reconnaissance examinations on a limited scale. It has been estimated that a large central belt of about 10,000 square miles, the greater part of which lies between the Churchill and Nelson rivers north of mile 130 (H.B.Ry.) and of which 50 to 75% is arable soil, could be made available for mixed farming. This central belt is composed of old interior lake beds whose even textured lacustrine clays have filled the valleys and transformed a broken country into one of more even and undulating topography. The clays are as much as 100 feet deep in places. The soils are all of drift material excepting the swamp soils. Ordinarily there is little surface cover as distinct from the subsoil which is low in organic content. Five to twelve inches below the shallow surfacing of decayed leaves and vegetation the clay is found, brown in colour from its association with the decayed matter, and quite friable. The swamp deposits on the other hand are composed for the most part of organic material consisting of layers of mosses and other vegetable matter which in the north especially shows little evidences of decomposition or alteration, due largely to the ground-ice or cold groundwater which prevents oxidation. Much of the clay land is muskeg covered and poorly drained, but these are difficulties which should be overcome with time and forethought and at no great expense. The rainfall is not heavy, the forest cover mostly light and the surface free from boulders, so that little difficulty should be met in draining, clearing or bringing the ground under cultivation.

The Saskatchewan river in its final stages flows through a fertile alluvial valley which in the vicinity of The Pas is unfortunately subject to inundation. Large areas of natural haylands of luxuriant growth are at present being used for cutting and grazing purposes, and engineering investigations with respect to the permanent reclamation of a block of these lands between the Saskatchewan and Carrot rivers have been carried out under the direction of the Department of the Interior.

The moss covered clay slopes running down to Hudson bay from latitude 57 do not support in their natural state grasses or vegetation of any economic value except in restricted areas adjoining the river systems. This is due to the fact that the subsoil is water soaked and frozen the year round. Just what the effect of draining these slopes and exposing the underlying soil to the sunlight by removal of the covering mosses would have with respect to underground frost conditions is problematical. There are many who contend that if such were done these extensive and hitherto valueless territories could be made to sustain a forest growth of great value.

The success of the gardening and experimental farming at the various trading posts over a long period of years is encouraging. At Lac la Ronge, Saskatchewan, which is in latitude 55°, between that of The Pas and Nelson House, wheat was matured for seven successive years without damage by frost. At Stanley mission, just north of Lac la Ronge, wheat, oats and barley have matured successfully. In the Nelson River valley wheat has been grown at Norway House and Cross lake and barley at Oxford House, all between 54 and 55 degrees of latitude, and potatoes and all ordinary garden vegetables at all the settlements up to and including those on Hudson bay. Cattle and horses and other stock can be and have been successfully wintered at all these places.

The present production of garden stuffs is for local consumption entirely. About 2,000 tons of native hay are put up annually in the vicinity of The Pas and Moose lake. In 1920 in addition to hay a considerable number of cattle were disposed of, the output being valued at $65,000. With shipping facilities available at Nelson there is no reason why a profitable stock and breeding industry should not be developed to supply the European markets, as cattle could be shipped from this district with a minimum of rail haul and could be delivered in England with a relatively small loss in weight.

Of the territory adjoining Hudson bay, the east coast from Cape Jones north (about 600 miles) is practically without soil. It is a country of moss and lichens and the same may be said of the coast north from Churchill. The so called barren lands which are found inland from Churchill are devoid of timber growth but support grasses and other vegetation upon which native grazing animals feed. Stefansson, the Arctic explorer, giving evidence before the special Senate Committee in 1919 suggested Churchill as the best headquarters for a musk-ox ranch because of its excellent grazing and shipping facilities. The coastal plain adjoining James bay, as examined for 90 miles south of Moose Factory, appears to consist largely of good quality clay soil covered with moss and muck from 2 to 6 feet thick. Land adjacent to the streams is of course better drained and free from moss and where not burnt over, supports a natural growth of considerable proportions. Barley, vegetables and hay are successfully cultivated in a small way at Moose Factory.

Minerals

The most outstanding mineralized area yet discovered in these parts is a belt 125 miles long and 20 to 40 miles wide extending east and west from Herb lake, Manitoba, to Amisk lake, Saskatchewan, and crossing the Saskatchewan - Manitoba boundary just south of latitude 55°. This is known as "The Pas Mineral Belt". The geology which characterizes it, Keewatin (including Huronian) formations between the limestone and Laurentian rocks (granites), is carried much farther and has been traced in a general way east as far as God's lake, Hayes river, and west to Lac la Ronge, Churchill river. This is similar formation to the mineralized portions of Northern Ontario.

Gold and copper are the outstanding discoveries so far, and, while production was attempted for a while, lack of capital in the one case and falling markets in the other resulted in the closing up of active properties till such time as power and transportation could be obtained and metal prices had recovered. The existing active camps beginning at the interprovincial boundary and going east are:

1. Flin Flon and Schist Lake camp
2. Athapapuskow Lake camp
3. Elbow Lake camp
4. Herb (Wekusko) and Little Herb Lake camp

The mineral formations as outlined by R. C. Wallace, Commissioner of Northern Manitoba in 1919, is made up of three classes grading into one another:

1. Gold in quartz veins carrying sulphide
2. Copper-zinc-iron sulphide bodies
3. Iron sulphide bodies

Due chiefly to difficulties of transportation, the mineralized sections of the more general Hudson Bay district have received very little attention. Doubtless with rail communication with Port Nelson, Churchill, or one of the James Bay ports much additional prospecting and development work will ensue. Of the islands to the north only a cursory examination of limited and coastal regions has as yet been attempted, although coal, iron, copper, gold, silver, lead and other minerals have been reported by explorers.

The following references summarize briefly the various native minerals of the railway belt and Hudson Bay coasts and their reported occurrences:

Antimony

Stibnite (antimony sulphide) is associated with the galena deposits north of Little Herb river, but to no great extent.

Anthraxolite

A bituminous mineral with the lustre and colour of anthracite is found in irregular veins or globules on Long island. It is not of economic value due to the small size of the occurrence and the high silica ash residue on burning.

Amber

This fossil resin is thrown up by waves on the shores of Cedar lake just south of the entrance of the Saskatchewan river in small broken pieces the size of beans. The amber is believed to be derived from the Tertiary or Cretaceous lignites occurring on the Saskatchewan. Its use as a filler in the manufacture of varnish has been suggested, but the present supply appears too uncertain and inadequate for any commercial development.

Arsenic

Arsenical pyrites (mispickel) is present in a diabase sill on an island in the Nelson river in the Pipestone Lake area, also on some of the Wekusko lake properties and south of Corbett inlet, Hudson bay.

Asbestos

Small veins of asbestos are known to occur south of the Little Whale river, on the Ottawa islands, Hudson Bay and on an island in Lac La Ronge, Churchill river, while another discovery is alleged to have been made near Amisk lake, Saskatchewan

Building and Ornamental Stone

Large quantities of magnesian limestone for quarrying are exposed close to the railway in the vicinity of Cormorant, Reed and Atikameg lakes. This stone could be taken out in blocks 1 - 5 feet thick and in all sizes and would prove an excellent stone for structural purposes. The granites on the Grass river below Reed lake are well coloured and seem of a type suitable for dressing and polishing. This stone can also be obtained near Grand rapids. Black marble suitable for quarrying has been reported by prospectors working northeast of Amisk lake. Building material of fair quality is found at Churchill. A variety of building stones are found on the islands and mainland of Hudson Bay between the Great Whale and Nastapoka rivers. On Walrus island of the Paint Hill group is found a porphyry rock holding pearly crystals of feldspar set in a dark green ground mass. Large slabs of this rock could be obtained for interior or exterior decorative uses. Agates, carnelians, epidosites and prophyries suitable for polishing can be obtained between Manitounuck and Nastapoka sounds.

Clay

Clay suitable for brick manufacture occurs over a wide area, from Setting lake to Armstrong lake (100 miles), in the valley of the Limestone river, in local depressions in the boulder clay, and just north of Manitou rapids, Nelson river. The more calcareous clays are to the south. All are free from pebbles and could be burned to commercial hardness at 1,800 degrees F.

Cement and Lime

The magnesian limestones which extend across the railway belt just north of the Saskatchewan river are suitable for burning for lime, while the upper portion of the series of the highly calcareous bituminous shales underlying the Pasquia hills can be used in the manufacture of cement. The pure dolomites of the Manitounuck islands would make excellent lime and cement materials, while a possible hydraulic cement stone is said to occur on Belanger, White Bear and the Nastapoka islands.

Coal.

A sample of lignite received by the Mines Department, Ottawa, in 1907, described as from "an unsurveyed area northwest of Cumberland lake, Saskatchewan", showed the following analysis: moisture 13.25%, volatile combustibles 28.97%, fixed carbon 24.80%, and ash (including sand) 23.00%. This was probably a continuation of the lignite deposits of Lac La Ronge and Wapawekka lake, Churchill river. Lignite is also found on some of the Ontario rivers reaching James bay. Discoveries of lignite in the Pasquia hills have been reported but not verified. Stefansson, the Arctic explorer says that he has seen coal in nearly every island north of Canada.

Cobalt

Cobalt has been seen in the form of fine-grained smaltite and cobalt bloom east of Big Island lake, and its occurrences is also noted in calcite veins on the Belcher islands but not in economic quantities.

Copper

Copper sulphides of large extent and varying richness occur in The Pas Mineral Belt between the Saskatchewan-Manitoba boundary and the Grass river.

From the Mandy mine, Schist lake, 26,000 tons of ore have been mined and transported by waggon, barge and railway to Trail, B.C. for treatment. This ore contained 19½% copper with gold and silver values. 180,000 tons are now blocked out, the estimated content being 6% copper, 20% zinc and values in gold and silver.

The Flin Flon mine is the largest known commercial ore body in the province, 16,000,000 tons having been blocked out by diamond drills, shafts and drifting with the following estimated average values: gold .081 oz. per ton, silver 1.17 oz. per ton, copper 1.83%, zinc 3.80%. Development of this huge deposit involves: building of an 85-mile, $2,500,000 (estimated) railway from The Pas to the property, harnessing of 10,000 hydraulic h.p. on Sturgeon-Weir river or Churchill river and the construction of a light railway from Flin Flon lake to the power house, the erection of a smelter on the property of at least 2,000 tons daily capacity and the establishment of a townsite for a population of 3000 to 5000. Fluxes could be obtained within about 15 miles or so, while the nearest suitable coal would be in Alberta. Important American capitalists have interested themselves in this property, and plans for a thorough milling test of the ores have been arranged, which if satisfactory will lead to the complete development of the property.

Electric smelting, a new metallurgical practice for the treatment of copper ores, has been considered in connection with the Flin Flon owing to the high fuel costs, enormous water powers being within transmission distances of the mines. The Bureau of Mines of the United States made experiments along these lines, though not on an industrial basis, which tended to show that with the cost of electrical energy at $16 per Kw. year and coke at $9 per ton the cost of the two processes would be about the same.

Interesting discoveries of considerable indicated importance have also been made at Cold lake 20 miles north of the Flin Flon and at Sourdough bay 11 miles to the east. Other occurrences are at the mouth of the Pineroot river, at Thompson and Twin lakes, all near Athapapuskow lake, and at Pipestone lake, East river, between lake Winnipeg and the Nelson. Some development work has also been done at Elbow, Copper and Little Herb lakes.

There are Huronian rocks on the main land of Hudson bay at Cape Fullerton north of Chesterfield inlet containing 4% copper pyrites, and chance specimens showing small quantities of nickel and copper have been picked up northward of Portland promontory in the vicinity of Mosquito bay with promising indications of sulphide ores in the form of pyrite, pyrrhotite and chalcopyrite.

Iron and copper pyrites are reported at various points on the east side of Hudson bay and chalcopyrite, occurring in metamorphosed limestone, has been noticed on the Belcher islands but not in economic quantities, and in the vicinity of Lac La Ronge, Saskatchewan.

Gold

The first important mineral discovery in Northern Manitoba was the gold strike at Herb (Wekusko) lake in 1914. Since then many valuable properties have been partially financed and developed and many others examined. While gold is found throughout the mineralized area the most striking finds are reported from the eastern half at Herb lake, Little Herb lake and Elbow lake. One of the Wekusko properties namely the Rex mine was developed to a producing basis in a small way, about $10,000 per month in gold being recovered while the mill was operating. This property might possibly be reopened as a subsidiary to the Flin Flon development. Very spectacular surface samples were obtained from Elbow lake and much activity is being shown by those operating in this district, but the persistance of values to depth has not yet been proven. Other claims have been staked on Pipestone and Little Playgreen lakes on the Nelson river and on Knee lake on the Hayes river and northwest of Amisk lake, Saskatchewan. The gold occurs in quartz veins carrying sulphide and is mined as a purely gold bearing rock or mixed with other metals.

Silica can be obtained from the numerous quartz veins in The Pas mineral belt, most of which carry gold values. This gold would be recovered in the metallurgical treatment of low grade copper ores such as the Flin Flon mine possesses.

Some pieces of vein-quartz picked up near the south side of Corbett inlet were found to carry a small amount of gold. Between Chesterfield inlet and Cape Fullerton there are several deposits of iron pyrites containing small amounts of gold. Free gold has been found in quartz at Repulse bay. Prospectors in 1912 reported placer gold on the banks of the Eastman river. Gold is reported near Great Whale river and on the Ottawa islands.

Placer gold reported from Chipewyan lake, Churchill river, was investigated by the Geological Survey, but only meagre and isolated values were obtained.

Free gold is reported by Dr. Rae at the head of Wager inlet west of Southampton island. There are large areas of dark basic rock carrying sulphides in contact with the granite of that district which makes it a field of some promise for prospectors.

Graphite

Extensive veins of this material have been noticed in Ungava bay, also near Cape Wolstenholme and along the east side of Baffin land and some claims have been staked in the vicinity of Churchill.

Glass sand

Quartz sand suitable for the manufacture of glass is exposed on the shores of Wapawekka lake, 150 miles northwest of The Pas.

Gypsum

Deposits of gypsum have been located on the Moose river between the Mattagami river and James bay.

Iron

Iron formations are known to exist over an extended area in the railway belt. Generally speaking they are sulphides occurring in association with Keewatin rocks and may be traced from Knee lake, one of the headwater bodies of the Hayes river, due west to Lac La Ronge in the province of Saskatchewan; occurrences, believed to be of commercial magnitude and purity, exist at various points along the Hudson bay shore line and especially on the islands of the east coast.

At Knee Lake the iron is present as a fine grained magnetite interstratified or interlaminated with schists. A sample tested about 45% iron free from titanic acid.

A loose specimen of interbanded jasper and hematite was found on the east shore of South Indian lake, Churchill river, and big ores cover a wide area near Wapawekka lake, Saskatchewan.

Clay ironstone beds in the Pasquia hills show an iron content of 29.1%

The Belcher islands, Hudson bay, possess formations of magnetite and hematite with which are associated iron silicate and carbonates. The formations outcrop as bands with highly ferruginous zones. Representative samples from these zones show an iron content of 35 to 45%. The high grade showings are for the most part interbedded with silicous material which would make for difficult mining operations. The ferruginous zones approximate an iron ore and more detailed examination of the field by trenching, test pits and diamond drilling might lead to the establishing of commercial bodies. One estimate indicates over 200 million tons of low grade ore in an area of 3200 acres.

The Nastapoka group, composed of 44 islands off Richmond Gulf on the east coast, forms a valuable series of iron properties. Two of the islands are said to contain from 3 to 4 hundred million tons of ore although much development work will be required to definitely prove up the field. The deposits are largely magnetite or a mixture of magnetite and hematite when associated with thin sandstone or jaspylite, and siderite and ankerite where associated with limestones. The ore beds are said to average 7-15 feet in thickness. Manganese was present in most of the samples analysed. A large number of claims have been staked and granted. The islands are within 1-4 miles of the shore where shipping facilities and water power could be obtained.

The carbonate ores are found on the Nastapoka islands in the upper beds and on the Hopewell chain and on Long island, the greatest thickness noted being about 20 feet.

North of the Payne river, Ungava bay, there are iron-bearing beds 420 feet thick occurring as carbonates or a mixture of hematite and magnetite associated with chert and jaspar. In places there are masses of pure iron but separation from the quartz would be necessary for commercial processes or quantities.

Bedded ores of low grade have also been examined in the south shores of Hudson strait and siderite ores containing 35-47% on the Mattagami river, James bay, and a 35% magnetite and hematite occurrence in sandstone beds, Sutton Mill lake district.

Lead

Lead is contained in the mixed ore of the Flin Flon mine and galena has been noted in small quantities at Herb (Wekusko) lake, Twin lake, Athapapusko lake, in a dyke on the west side of Copper lake and at Manipigon lake near Nelson House.

A deposit of galena carrying silver values in the Cambrian limestones in quantities sufficient to be of economic importance was traced for 12 miles from Little Whale River to Richmond Gulf, Hudson Bay. Assays gave 5.04 - 12.03 oz. silver per ton. The Hudson Bay Company mined a lead property at the Little Whale river at one time, but workings were later abandoned.

Manganese

Important deposits of spathic iron containing manganese exist on the Nastapoka islands. A sample from Flint island showed 25.44% metallic iron and over 24% carbonate of manganese. These deposits are accessible and of promise commercially. They might be used in the manufacture of spiegeleisen.

Mica

Mica, occurring in large plates of green muscovite in massive pegmatite dykes, has been observed between Talking and Island falls on the Eastmain river.

A Scotch whaler took out 13 tons of excellent mica from a mine at Lake Harbor, Hudson strait, in 1903.

Prospectors have also registered some claims near Churchill and a small sample was obtained from an island in Cross lake, Nelson river.

Molybdenum

At the south end of Phantom lake in the Flin Flon area a quartz vein near the granite contact, containing pyrite, chalcopyrite and considerable molybdenite was traced for 100 feet with an average width of 3 feet. Other evidences of molybdenite have been obtained in the vicinity, as well as at the Dominion claims, Brunne lake, where it occurs as flakes in fissures of the quartz, on the shores of Little Playgreen lake near the exit of the Nelson river from lake Winnipeg, where the occurrence takes the form of round crystal aggregates in red pegmatite, on the Echimamish river at a contact between gneiss and intrusive rocks, on the west bank of the Grass river near Wekusko (Herb) lake, on the Eastmain coast, Hudson bay, and as plates in syenite dykes on the Paint Hill Islands, James bay.

Nickel

Near Mile 196, Hudson Bay railway, contact of greenstone and gneiss shows mineralization of magnetite, pyrrhotite, and chalcopyrite with low values in gold and nickel. Pyrite and pyrrhotite containing slight quantities of gold, silver and nickel are noted on Webb creek north of Elbow lake. These claims were only imperfectly prospected owing to the swampy nature of the district, but values obtained were not encouraging. Nickel associated with pyrites is stated to occur in veins at Camping island, 10 miles south of Priest's Point, Reindeer lake, Saskatchewan.

Oil shales

Oil shales 150 feet thick are exposed on the Carrot river and on the northern and eastern slopes of the Pasquia hills. The beds are horizontal and would appear to underlie the entire range. Samples from surface exposures analyzed 7 gallons crude oil and 20 pounds of ammonium sulphate per ton, but do not of necessity represent the richest beds. The federal Department of Mines is investigating the problem of extraction of oil from such shales. Some drilling for oil has been done near the junction of the Carrot and Man rivers.

Pigments

Mineral springs depositing ochres and umbers which might be utilized in paint manufacturing are found 150 miles northwest of The Pas at Wapawekka lake. Red ochre in small quantities but of good quality has been found on Cross lake, Saskatchewan river. Several claims are staked.

Peat

Formations of peat are widely distributed over the entire railway belt, although ground ice such as is found in the more northern swamps tends to retard their formation. Amongst the bogs of commercial possibilities might be mentioned (1) north of Grand rapids, Saskatchewan river, (2) between Grass river and Beaverhouse lake on Burntwood river, (3) Little Churchill river near Switching river (4) on creek north of Hudson Bay post at Split lake, (5) both sides of south part of Waskaiowaka lake, (6) outlet of Assean lake, (7) 21 miles below the forks, Churchill river, (8) Lagoons 12 miles south of Recluse lake (9) between Deer lake and Churchill river (10) northwest side of Swampy lake below Knee lake, Hayes river, (11) near Clearwater lake, Mink river, (12) near Swampy Portage lake between Knee and God's lakes.

Platinum

Platinum values have been obtained on the Caribou claims, west side of Brunne lake, and on claims north of Cranberry lake and near Wekusko (Herb) lake. They are not commercial deposits in themselves.

Quicksilver

Dr. Alexander Brown, surgeon at Churchill, gave evidence before a British Parliamentary enquiry in 1748 that a red earth, obtained 36 miles south of the Churchill river, reacted like cinnabar, the ore of quicksilver.

Salt

A series of natural salt springs extends from the Carrot River valley southeast along the west side of Lake Winnipegosis and beyond. At one time crude evaporation methods were employed to obtain salt for local purposes but at present none is obtained locally.

Silver

Silver occurs in The Pas mineral belt and is recovered in connection with the gold and copper ores, a total of 15,510 ounces having been produced in 1920, since when production has ceased. The gold-silver-copper camps are Schist lake, Athapapuskow lake, Flin Flon lake, Hole river, Copper and Brunne lakes. The silver content of the Flin Flon 16,000,000-ton ore body is estimated at 1.17 ounces per ton, while the treated ore from the Mandy mine showed 2½ ounces per ton.

Silver-lead ores are also reported from Pukkatawagan or Gold lake, from northeast of Herb lake, from the Copper and Brunne lake district, and from Wanipigon lake north of Nelson House. Segregated pyrite in the squeezed trap of the Paint Hill area carry small silver values. Galena showing silver values of 5.04 - 12.03 ounces per ton from samples has been traced for 12 miles from Little Whale river to Richmond Gulf.

Sulphur

The presence of large and widespread iron and copper sulphide bodies at various points in the Keewatin belts suggests a possible source of sulphuric acid or sulphur. Among the sulphides found in the railway belt, on the Churchill river and along the coast are iron pyrites, chalcopyrite, bornite, arsenopyrite, sphalerite (zinc blende) stibnite (sulphide of antimony) and pyrrhotite.

Many of the properties on Ross lake, northeast of Schist lake, on the Pineroot river, at the north end of lake Athapapuskow, and on Brunne and Copper lakes show characteristic occurrences of iron pyrites in extensive zones and bands, associated in part with copper values, in origin similar to the Flin Flon and Mandy ore bodies.

Iron pyrites appear in the limestones of Long island, on the East-main river and on the islands north of Cape Jones, and in the Paint Hill group; the vicinity of Mosquito bay, north of Portland Promontory appears to be an area favourable to these sulphides. Pyrites has also been noted on the west coast near Corbett inlet, in Mistake bay and other places.

Talc

Soapstone obtained near Mosquito bay is used by the Eskimos of the East coast for making utensils. A possible source of material for fire clay is found in the pipestone from Wapawekka lake, Saskatchewan, 150 miles northwest of The Pas.

Zinc

Zinc is associated as sphelerite with the copper sulphide ores of The Pas mineral belt, the Flin Flon mine showing an average zinc content of 3½% while the ore of the Mandy mine runs about 20% zinc. It is also associated with calcspar in veins south of Little Whale river and as crystals in galena on this part of the coast.

FORESTS

Northern Manitoba while predominantly a spruce country may be roughly divided into two general flora zones by a line crossing the Hudson Bay railway at Mile 150 at right angles. Northeast of this line is the northern coniferous spruce-pine zone while to the south and southwest as far as the Riding mountains (Latitude 51°) there are the mixed woods, poplar, birch, spruce, tamarack, cottonwood, willow and the various undergrowths common to them. South of Latitude 56° the country is almost continuously although not of necessity commercially forested, while the more strictly coniferous zone thins out into occasional treeless tracts there being two such of approximately 1,200 to 1,500 square miles each south of the Churchill river. The shore line of Hudson bay is also largely devoid of standing timber. The valleys along the east coast of Hudson bay are forested as far north as Richmond Gulf, but the trees are small and the branches continue to the ground so that the trunks are full of knots and of little value. The islands off the coast are for the most part barren.

S. C. Ells, who examined the coastal plain bordering James bay for the Temiskaming and Northern Ontario Railway Commission, says of it that for 90 miles south of the bay it is decidedly not a timber country except in the limited districts adjoining creeks and rivers. He reports among other things: that the country cannot hope to export timber products but can expect sufficient for local uses for some time to come; that portable sawmills are the only means of handling the small cuts available; that the largest single observed area of pulpwood of good quality and growth was estimated at 1,000 acres only; that in the burnt areas there is sufficient fire wood to last the settlers for several years.

Fires and Lack of Drainage

In many parts of the railway belt and elsewhere, forest growth has suffered much from fire and has been seriously retarded by the lack of drainage. For long distances only isolated ridges and points or islands are left unscathed, and in addition the contractors on the railway construction operated logging and tie camps wherever practicable, so that the supply of matured commercial timber at points available from the railway may be said to be strictly limited. Mr. Dickson of the Dominion Forestry Branch in his examination of these woods in 1911 as a possible source of supply of structural timber for the railway reported that only "a mere fraction of one per cent" of the area he surveyed carried merchantable trees. The situation is probably even less favourable now than then, but should gradually improve with the coming on of second growth, which in this district is of two general age classes, one 40 to 50 years, and another 80 to 90 years, graduating in size from 3 to 10 inches diameter.

Mature or young growth of black spruce is to be found in patches along the water courses from the Churchill river to James bay. The water courses are separated usually by wide stretches of muskeg, either barren or carrying a sparse growth of stunted black spruce or tamarack of no commercial value. Excepting in the limited clay belt areas, present data indicate that unless the general drainage scheme can in some way be improved the country will remain permanently incapable of supporting any large pulp industry. Several power sites are available of which White Mud Falls on the Nelson river, owing to its proximity to one of the clay belt areas, may some day be utilized for the establishment of such an industry.

The clay belts in question while at present largely burnt over, will, with proper fire protection, produce in the future, considerable quantities of timber useful for pulp and paper making. The pulpwood assets of the territory drained by the Hayes and Churchill rivers are not sufficiently well known at present to judge what their future may be, although

it has been claimed that the Hayes could support a pulp industry with mills at its confluence with the Fox or Shamattawa rivers. Sgt. E.H.L.Thompson, N.W.M.P. giving evidence before the special senate committee of 1919 said that he had travelled for seven weeks up the Hayes and Shamattawa rivers to the Trout Lake Hudson's Bay Company post without seeing more than one half dozen good tree specimens. Fire had swept the country, and the average diameter of the timber was only 2 to 3 inches.

The scattered nature of the stands and turbulent character of some of the log-driving streams tend to render logging operations expensive if not prohibitive in many localities.

Commercial species

The commercial species are white and black spruce, poplar, tamarack, birch and jackpine of which in the railway belt all but the white spruce are, in their present condition, suitable only for fire wood or pulp manufacture. The mature tamarack has been killed by insect life but is still standing and could be used for fire wood and possibly for minor structural purposes. Of the two spruce species the black is the predominant but the less valuable. It runs up to 16 inches in diameter, and in well drained districts it is occasionally larger. The more swampy regions possess no other woods than black spruce of a dwarfed or knotty type. White spruce favours the ridges and high lands surrounding the numerous lakes. It averages 12 - 24 inches in diameter and is valuable both as lumber and pulpwood and for the most part could be cut into three 14-foot logs. Poplar (aspen) and birch are widely scattered. The former is a suitable wood for both lumber and pulp but does not lend itself to river driving or rafting. The light wood and close grain of the birch makes it suitable for spools, lasts and turned work.

The only large lumbering industry is at The Pas where The Pas Lumber Company owns a big mill and employs a large number of men in its plant and camps on the Carrot river and Sipanok channel. A representative annual cut would probably be 35,000,000 feet which valued at 21 dollars per thousand feet would make $735,000 for the season. In railway construction days several tie camps were maintained on the Saskatchewan and tributaries of the Nelson river, while the Roman Catholic Mission at Cross lake and some of the mining companies have installed small portable mills to get out lumber for their own purposes. The Hudson's Bay Company and the Revillon Company have successfully operated small mills at Moose Factory, James bay, about 1000 logs per mill being obtained locally each year.

Rate of Growth

The future of Northern Manitoba will be greatly influenced by the rate at which new forest growth reaches maturity. The following estimate has been made from observations of an official of the Dominion Forestry Branch:-

Species	Soil	Breast Height Diameter	No. of years
Black spruce	semi-muskeg	4-5 inches	100
White spruce	ridges and well drained acres	8-12 "	100
Poplar	"	8-10 "	100
Birch	"	10-12 "	100
Jackpine	Sandy	12-16 "	Limit of Maturity
		4-6 "	Average good Stand

As will be seen this growth is extremely slow and every precaution against destruction by fire, insect pests or indiscriminate cutting will have to be maintained. Nevertheless it is by no means discouraging as measured by growth in other and more highly developed timbered areas. The

the diameter of "Norway" spruce as grown in Sweden is under 8 inches at breast height in 100-year old trees, as compared with 8 - 12 inches for white spruce in the localities under discussion. Under the handicap of such slow growth Sweden has developed a forestry system to permit a total annual value for forest products of over 100 million dollars from an area considerably less than that of Manitoba. With proper protection and interior drainage there is no reason why the country between Lake Winnipeg and Hudson Bay could not become one of the most valuable spruce holdings on the continent; the soil is suitable; the climate is favourable; splendid manufacturing sites exist; and markets both in the west and abroad seem assured.

The fisheries of Hudson bay and of the lakes and rivers running into it should with reasonable protection prove a source of perpetual revenue and food supply. The natural stock is everywhere plentiful, of superior quality and considerable variety. Most of the Hudson bay fish are believed to be fresh water fish which have adapted themselves to salt water conditions although continuing to run up the rivers periodically. The local industry upon which native life so largely depends takes advantage of this circumstance, the Indians doing most of their netting in the rivers.

Current operations

Large quantities of fish are taken from the lakes accessible from the railway. During the winter and summer seasons of 1921 fish to the value of $129,700 were taken in The Pas district for commercial purposes and the general average value of the northern catch is probably about $100,000. This does not include large quantities used locally of which dog food forms an important item. The fishing for scale fish is done largely in winter by netting through holes cut in the ice, the product being shipped in a frozen condition. Despite the long sleigh hauls to the railway, sometimes necessary, the industry has on the whole been quite profitable. Large quantities are also sent via Selkirk from lake Winnipeg where regular fleets are employed, and from the adjacent waters.

A sturgeon fishery developed on the Nelson river with a fleet of boats and tramway lines across the portages was obliged to close due to the high overhead charges which made operations unprofitable. It is customary to take the sturgeon alive and keep them so till convenient to market them.

Whalers from the United States and Europe have visited Hudson bay regularly for the past century but due to the gradual extinction of the Right whale the fleets are becoming smaller. The Hudson's Bay Company in addition to large catches for the use of its employees and retainers and their dogs has been known to ship fish as refrigeratory and as salted cargoes in regular export trade with the Old Country.

Future of Industry

The completion of the Hudson Bay railway or the Temiskaming and Northern Ontario railway would be of great benefit in the development of the apparently considerable fish resources of Hudson and James bays, as a direct outlet to American and Canadian western or Ontario markets would then be available. A branch railway through the mineralized belt, such as has been proposed, would also make accessible several large inland lakes lavishly stocked. There are so many fish in some of the lakes that supervised exploitation would probably be more beneficial than otherwise.

It is doubtful if the Hudson Bay fisheries would be profitable to other than resident fishermen. The season is from the middle of June to August when fish are on the coast after migration and again in September and October till the ice sets in. It is also possible that winter fishing through the ice could be developed; otherwise supplementary occupations such as trapping or a change of operations to the inland lakes would be necessary for the remainder of the year.

The flatness and shallowness of the west coast and consequent disturbed condition of the water from winds and ice does much to discourage both fish and fish-food life there. The lack of harbours except at high tide for boats of very shallow draught is another feature that makes the east coast a preferable fishing ground.

Officers of the Department of the Naval Service who made a reconnaisance of the bay from a fisheries standpoint in 1914, have suggested drift nets of 2" - 3" mesh and fixed floating nets of $2\frac{1}{2}$" mesh for the estuaries and rivers as the best types to be employed. Experiments at "bottom" fishing in the bay and strait have been consistently fruitless.

There is need for the study of the habits of the northern fish so that definite regulatory and administrative improvements could be effected, not only to preserve existing species, but in some cases to supplement them with new stock and stock varieties and to encourage the taking of destructive fish and animals who prey upon the food fishes.

Commercial fishing in Northern Manitoba is regulated to seasons and subjected to certain conditions. Licenses and full particulars can be procured from the Fisheries Branch, Department of Marine and Fisheries, Ottawa.

The fish most frequently met with are hereunder briefly described:

Cod

True cod are known to inhabit Ungava bay and have been reported at Cape Wolstenholme, but it has not been proven that they extend into the bay in any quantity. The rock or Greenland cod is taken along the east coast northwards from the Eastmain river. It averages 2 to 7 pounds, although running as high as 20 pounds, and is slightly inferior in quality to the Atlantic cod. It is usually caught in shallow water off rocky points, but its habits are largely a matter of conjecture. The climate is not favourable to drying the product; salting has been suggested.

Capelin

This little fish, valuable mainly as food for cod and other important fish, is plentiful in Hudson and James bays, and is sometimes thrown up on the beaches during a storm. It spawns near the shore and then takes to deep water.

Crabs

Large sized specimens are sometimes found in Hudson bay, but the natives do not eat them.

Chubb

The chubb is a common frequenter of the James Bay rivers. It is not a favoured food fish.

Goldeye

This fish is mostly found in the rivers of James bay, although specimens have been taken farther north.

Grayling

Grayling is reported from the Churchill river and other streams further north.

Herring

True herring are not believed to be native to Hudson bay, but the lesser white fish, sometimes called herring, corresponds to the so-called lake herring, being superior to sea herring and with fewer bones. The Mooneye or Toothed herring, resembling a small shad, migrates up and down the rivers and is caught in large quantities.

Halibut

Halibut have been reported in the neighbourhood of Resolution island, Cape Smith, the Cape Hope islands and at Port Nelson, but their presence in Hudson bay in quantity has never been established.

Ling or More

This freshwater representative of the cod family is found in all northern waters, mostly in the estuaries during the winter months. It spawns under the ice in February and March. It possesses a large liver which has valuable food properties. The ling runs up to 25 pounds in weight and is usually 2 to 2½ feet long, and very destructive in it's habits. It would make excellent food if existing prejudice against it were overcome.

Pickerel

Specimens up to 9 pounds have been taken from the Nelson river and large quantities of about 3 pounds each are to be secured in all the inland freshwater bodies. It does not enter salt water but is often found in brackish estuaries. It is a good food fish and is sometimes known locally as perch.

Pike or Jackfish

This destructive fish is found in the lakes or headwaters of the various rivers plentifully during the summer and has also been caught in the salt waters of the estuaries. The flesh is better in quality than that taken further south. Ten pounds is considered a large specimen.

Salmon

Two species very closely related are found in Hudson bay and to some extent in James bay, the long-finned charr and the Greenland charr or Hearnes salmon. These fish are seldom found further south than the Churchill river on the west coast, or Cape Jones on the east coast. They frequent all rivers with sand or gravelled beds proceeding upstream to spawn about the middle of August and returning at the breakup in the following spring. They are sometimes found migrating in enormous quantities. If this be their regular habit in certain districts a canning industry could possibly be established, for the fish is of excellent quality, the flesh being pink in colour and very firm. Specimens up to 30 pounds have been obtained, although 5 - 15 pounds is a more representative weight. Land locked salmon are found in some of the inland lakes and while not to be had in commercial quantities, as a big game fish it has few superiors.

True salmon are seldom seen in Hudson Bay proper, although considerable numbers are known to exist in Ungava bay, where the Hudson's Bay Company have operated fisheries on the Georges, Whale, Leaf and Koksoak rivers, from which salted, pickeled and fresh fish have been shipped to England.

Shad

Shad have been seen in the Nottaway river, James bay.

Shellfish

Large quantities of empty shells on the beaches of Hudson and James bays indicate presence of clams, scallops and mussels. The latter is an excellent bait for cod.

Suckers

Various members of the sucker family live in all the inland waters - lakes, rivers, creeks and ponds. They are easy to capture and are fed by the Indians to the sleigh dogs.

Sculpin

The sculpin or wind fish is a small scaly, salt-water fish found in Hudson bay. The liver is edible and the tail is considered a delicacy by the Eskimos.

is captured by nets, spears and hooks and lines. Common practice is to pen them alive till they can be shipped out by boat or rail. The flesh commands a good price and the roe can be retailed as the best Russian caviare. A mature female is valued at between one and two hundred dollars; in size they vary from 5 to 100 pounds or over. The air bladder is dried and yields isinglass. Scientific study of the life and reproductive habits of these fish and careful regulation of the sturgeon fisheries are urgently needed to prevent its extinction here as has happened on the St. Lawrence.

Tullibee

The tullibee is an extremely plentiful and valuable Hudson and James Bay fish, which closely resembles the whitefish both in appearance and habits. It spawns in October, is 1½ feet long and reaches a weight of about 3 pounds. It is not unlike the Great Lakes herring except in size. As a coastwise fish such quantities could be obtained especially amongst the islands of the east coast that the possibilities of a canning industry merit investigation. It has an excellent flavour but deteriorates rapidly.

Trout

Lake trout are prevalent in all the larger lakes and to some extent in the rivers but never in their estuaries. They spawn in September around shallow gravel bars. The flesh has an excellent flavour and the Indians sometimes cure it by smoking. Specimens up to 40 and 50 pounds are caught but 10-15 pounds is the general run.

River and salmon trout, believed to be the same fish with some variation of colouring, leave the rivers for the sea early in June returning in July and August, their bright colour gone, and spawning in October. They run from 1 to 5 pounds. In the smaller streams they take the fly readily, the small varieties being practically identical with eastern brook trout and staying in fresh water the year around. Trout can be salt cured successfully.

Whitefish

From a general commercial point of view the whitefish is the most important and prolific of the northern fish. It is found in all the lakes and rivers and where the opportunity occurs it has taken to salt water, ascending the rivers only to spawn early in October. The fresh water variety average 2 to 3 pounds, about 1 pound lighter than the salt water species, but to all intents and for all purposes they are the same fish. The flesh is excellent and can be cured by smoking. They may be caught by nets and seines not only in the rivers and estuaries but along the coasts from early in the spring to the end of July and again from the end of August to on in the fall.

Whales

The whaling industry in Hudson bay has had a long history and for a time great prosperity. European whalers entered these waters as early as 1619 followed by New England ships in 1846. Both ships and land stations and white and Eskimo labour are employed. It has been estimated that in the last 45 years 2000 whales yielding 1000 tons of whale bone and 23,000 tons of oil worth $17,000,000 have been taken in Baffin and Hudson bays by boats from European and United States ports. At present whaling is highly speculative due to the uncertainty of obtaining even a single carcass in a season. Whale bone is quite valuable but the oil from the blubber has to meet competition from mineral oils. The hunting grounds which formerly extended as far south as Marble island now are in the waters around Southampton island and in Hudson strait. The whales are usually found close to shore ice or loose ice fields where they obtain both food and protection. Most of the whales captured are taken within 3 miles of the shore. They are known to pass westward through Hudson strait early in the spring and again late in the fall going eastwards.

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By far the most valuable whale species is the Right, Bowhead or Greenland whale. It is about 50 to 60 feet long, travelling in pairs or groups by inclination, but it has been so ceaselessly hunted that now even single specimens are rarely seen. It yields whale bone, leather and oil, a single specimen being worth from $5,000 to $30,000, according to size. Other large but less valuable types are the Big Finner, Little Finner, the Humpback and the Killer. The last named, also known as the Grampus, is very destructive, eating porpoises and seals and even attacking the great Right whale who retreats to the ice floes for safety.

The beluge, white whale or porpoise, is found over the whole of Hudson and James bays in sufficiently large numbers as to suggest an industrial development. They feed on white fish and capelin and follow the migrating fish for considerable distances up the estuaries. They could be easily captured and would yield considerable oil, leather and other by-products on treatment. The Hudson Bay Company had commercial fisheries for this animal 150 years ago, but the industry has since declined. Their chief use at present is as dog food, and, since they are a serious menace to fish life, their destruction should be encouraged. The products of this animal should with proper treatment yield about 30 dollars.

The narwhal or sea unicorn is a rare and valuable species occasionally found in the northern waters of the bay and strait. It possesses a long ivory spiral horn extending forward from the upper jaw, sometimes 8 feet long when mature, and valued at about $3.00 per pound.

Game and Fur

This is a game country of easy accessibility and prolific variety.

Moose and deer are numerous in the wooded areas.

The barren ground caribou come as far south as the Churchill river, and woodland caribou are scattered throughout the timbered districts.

Wolves follow the caribou.

The polar bear roams a wide area of Hudson bay dividing his time on the ice, in the water and on land.

The musk-ox seldom leaves its grazing lands on the Arctic islands and mainland northwest from Hudson bay. It has been proposed to domesticate this animal for its meat and possibly its wool, and ranges on Southampton, Coats and Mansell islands and near Churchill, where it formerly was native, have been suggested. It weighs about 1,000 pounds on the hoof and 450 pounds dressed. The hide if taken in winter is valued at 75 dollars. The yield of wool is about 50 pounds annually of exceptionally high grade. The three islands mentioned have already been set aside as grazing reserves for musk-ox and reindeer by Order in Council of date March 10, 1920.

Fur bearing animals are extremely numerous including wood, marine and Arctic types.

The seal family is valuable for its fur, leather and blubber upon which the Eskimos are so dependent. The hair rather than the fur seals are found in Hudson bay; the chief species are the Bearded and Ringed seals and Harbour seal, the latter frequenting fresh water. Walrus are found in Hudson bay north of Latitude 52°. They are hunted commercially for their hide, ivory and oil, a specimen being worth from 30 to 40 dollars. They sink on being killed and large numbers are lost in that way.

Other fur bearing animals include: foxes (coloured, cross, and white), otter, fisher, marten, mink, beaver, lynx, skunk, muskrat, weasel, black, white and barren-ground brown bear, ermine, wolverine, etc.

The annual output of fur passing through The Pas is valued at one million dollars and in one year (1919) the catch was valued at at least twice that amount. This does not include the quantities of valuable pelts which leave the country via boat from Hudson Bay ports.

Fur farming in these territories dates back to 1846 when the Hudson's Bay Company successfully introduced a colony of beaver on Charlton island, James bay.

Posts trading with the Eskimos employ a system of tokens by which the following relative values for furs are established: white fox equals one token; blue fox, two; cross fox, five to fifteen; silver fox, fifteen to forty; otter, four to eight; mink, one; marten, two; white bear, four to ten; deer skin, one-half.

Bird life is largely seasonal. Pelican, swan, ducks and geese breed in the vast marshes and along the innumerable lakes lying between the Saskatchewan river and the Arctic waters; probably nowhere in the world can they be found in greater numbers or in a more undisturbed state.

Non-migratory birds, consisting chiefly of ptarmigan in the northern and grouse in the southern part of the railway belt, are also plentiful.

Water Powers

Enormous quantities of hydraulic power are within transmission distance of the railway belt, the Nelson river alone being capable of almost two and a half million horse power at ordinary minimum natural flow. The following estimates are the result of investigation by the Dominion Water Power Branch under whom the powers in the prairie provinces are administered.

River	Province	No. of sites	Heads in ft.	Ordinary minimum flow in second-feet.	H.P. at ord. min. flow with 80% efficiency
Nelson	Man.	22	6-52	50,000	2,443,320
Churchill	Sask.	88	8-70	3,800 - 20,000	255,870
	Man.	8	10-34	20,400 - 24,000	325,500
Hayes	Man.	20	5-56	65 - 506	7,611
Reindeer	Sask.	4	5-30	1,600	93,070
Sturgeon-Weir	Sask.	3	10-30	1,200	5,660
Saskatchewan	Man.	3	10-57	5,970	58,614
Burntwood	Man.	4	34-84	405 - 550	9,060
Grass	Man.	5	37-55	110 - 338	5,131

Further surveys and provision for storage will no doubt greatly add to the above figures, which are conservative in every respect.

In connection with the proposed smelter at the Flin Flon mine it will be necessary to obtain power either from the Churchill, Saskatchewan or Sturgeon-Weir rivers. The Scoop Rapid site on the latter is most favoured.

Of the other rivers flowing into Hudson and James bays it may be generally stated that those draining from the west are of gradual descent in their lower reaches and possess few falls of consequence within economic transmission distance of tide water, while those coming from Quebec territory possess important power sites, many at or close to the coast. From present sources of information the Eastmain, Rupert, Nottaway and Great Whale rivers are capable of furnishing about three quarters of a million horse power at ordinary minimum flow. Nastapoka falls, adjacent to the Nastapoka iron fields, has a descent of 170 feet and the Wyachuan river has a fall near Richmond gulf of 315 feet and the Langland river one of 60 feet near its mouth.

Uses for this power have not been developed as yet, but three logical industries, all of which depend on cheap power in large quantities, suggest themselves - 1. Smelting of copper and iron ores in electric furnaces, 2. Production of fertilizers by fixation of atmospheric nitrogen. 3. Pulp and paper enterprises.

NAVIGATION

Boats of all sizes and descriptions from small sailing craft to modern ocean freighters have been entering and leaving Hudson bay via Hudson strait for two and a half centuries, during which time the losses have been reasonably light, the records of the Hudson Bay Company, which are especially favourable, showing the destruction of only two ships. In recent years as many as 38 recorded passages have been made through the straits in a single season (1914) without serious accidents. Many divergent opinions have been expressed as to the duration of the navigable season. The ice packs from Fox channel which are carried by wind and currents into the straits in early summer, the snow storms which often prevail after the middle of September, and the long hours of darkness and cold late in the fall, are serious menaces to a prolonged shipping season. Aids to navigation such as lighthouses, wireless, special pilots, aeroplane observation of the ice packs, etc., would be of material assistance in enabling boats to make the passages successfully in June, July, October and November. The bay itself could possibly be navigated the year round if the harbour approaches were kept open by ice breakers. In October and November and early in the season, before the ice is completely melted, several days of fogs and haze may be encountered, but for the most part the weather is clear. Serious magnetic disturbances of the compass must also be allowed for.

Currents

Two prevailing ocean currents, one eastward and one westward, can be traced in Hudson strait, both of which have an important bearing on navigation, due to the ice fields they carry with them. From the Atlantic a branch of the main Arctic current flowing south through Davis strait enters Hudson strait at Resolution island and can be traced along the north shore as far as Big island, where it is believed to turn and work its way back eastward. In November and early in December this current brings field and berg ice with it which, under certain conditions, blocks the Atlantic entrance to the straits.

The eastbound current comes from Fox channel and is diverted by Southampton island so that it follows the southern shore of Hudson strait, joining the Labrador-bound Arctic current just off the Button islands. The ice which it carries is ordinarily found at the western entrance late in the fall and early in the summer 'rafted' together under pressure and forming fields of wide, irregular surfaces and impenetrable bulk. These packs begin to melt in June and during July the cementing ice material is sufficiently thawed to permit a steamer cutting through, the ice masses falling into pieces with considerable commotion, but with little risk of damage to a well-built boat.

Currents starting in Roes Welcome also follow the coast of Hudson bay, travelling south on the west side and north along the east shore, but they carry relatively little ice and form no impediment to navigation.

Length of Season

A brief tabled summary of the published opinions of a large number of men - mariners, scientists, government officials, explorers and traders - all experienced or well informed on the difficulties of travel in northern waters - as to the opening and closing dates for navigation in Hudson strait, is herewith presented.

Statements re
Navigable Season in Hudson Strait

Witness		Years in Northern Waters	Opinion as to Season for Navigation in Hudson Strait. Begins	Ends	Duration
Capt. F. Anderson,	Canadian Naval Service, in command of Expeditions 1911 - 14.	4	July 15	Nov. 15	17 weeks
Capt. H.E. Webb,	S.S. Bonaventure	2	July 25	Oct. 15	12 "
Thos. Harling,	Ship broker, Montreal		"3 summer months"		13 "
N.B. Saunders,	Agt. Dept. Rys. & Canals		Aug. 1	Oct. 28	13 "
Capt. Wm. Wakeham,	Dept. Marine & Fisheries	several	July 1-10	Oct. 15-20	14-16 "
Capt. M. Bartlett,	with Com. Lowe S.S. Neptune	1	July 31	Nov. 1	13 weeks
Capt. A. Kean,	S.S. Prospero	40	Aug. 1 (For ordinary vessels)	Oct. 31	13 "
			June 30 (For special boats)	Nov. 30	22 "
Capt. C. Couch,	Newfoundland	8	July 15	Oct. 5	12 "
Capt. C.R. Sinclair,	Merchant Navy	6	"3½ - 4 months"		15-17 "
Capt. Adams,	Whaler "Arctic"	35	June 20-25	Oct. 25	18 "
Admiral Markham,	Accomps. Com. Gordon on Official navigation investigations, 1886.		variable	variable	17 "
Dr. Robt. Bell, F.R.S.	Geologist Scientist	17	June 15	Oct. 20	22 "
Commander Gordon,	Commanding expeditions 1884-6.	3	July 1-10 (Delays in July passage)	Oct. 1-10 (for fortified boats of 2000 tons)	12-15 "
Lt. Schwatka, U.S.N.	Post-Franklin Expedition	2	"4 months"		17 weeks
A.P. Low, F.R.G.S.	Director Geol. Surv. Exped. 1903-4.		July 20	Nov. 1	15 "
J.W. Tyrrell	Explorer, Engineer		July 15	Nov. 1-15	16-18 "
W.A. Bowden,	Chief Engineer Dept. of Rys. & Canals.		Aug. 1.	Nov. 1	13 weeks

Witness		Years in Northern Waters	Opinion as to Season for Navigation in Hudson Strait		
			Begins	Ends	Duration
Capt. J. E. Bernier,	Explorer Navigator	19	variable	variable	17 weeks
Capt. Bishop,	H.B.Company "Prince of Wales"	several	Aug. 1		
Walter Dickson,	Hudson Bay Company	20	"5 months"		22 "
Capt. Silsby,		several	July 1	Oct. 31	18 "
Capt. Wm.Kennedy,	Post-Franklin Expedition & H. B.Co.,Ungava bay.	8	Aug. 1	Nov. 1	13 "
Capt. Hawes,	Hudson Bay Co.	14	July 15	Oct. 15	13 "
Capt.Thos.McKenzie,	Whaler, New Bedford	2	July 15-20	Oct.10-15	12-13 "
Capt. E.B. Fisher,	Whaler,East Falmouth.	33	variable	variable	13-15 "
Capt.T.C.Clisby,	i/c Whaling fleet of C.A. Williams Co.	14	July 1	Oct. 31	18 "
Capt.John Spicer,	Whaler, Grotan.	20	July	Sept.	13 "
Capt. W. Coates,	H.B. Co. 1727-1751.	24	July 1	Sept.15	11 "
Capt.Edmund Mack,	Navigator	18	Aug. 7	Oct. 10	9 "
Capt. R.H. Taylor,	"				2½ months
Capt. Folk,	Job Bros.Ltd. steamship owners,St. John's Nfld.		Aug.1		2½-3 "
Capt.T.R. Randell,	St.John's Nfld.		variable		2 " (average)
Capt.Norman E. Freakley	Navigator	20 trips	Aug. 1	Oct. 15	11 weeks
D.W. McLaughlin	Engineer i/c H.B.Ry. Terminals		Aug. 20	Oct. 15	8 "

Types of Boats

Testimony before the special committee of the Senate, 1919, tended to indicate that boats on this route should be limited in size to under 5,000 tons deadweight capacity - preferably 3,000 tons with 17-foot draught, specially designed to avoid the vertical sides typical of the lake carriers and with bows properly reinforced. Capt. Bernier thought any size of boat could be used provided the design were correct, while W.A. Bowden, chief engineer of the Department of Railways and Canals suggested boats of 7,500 to 8,500 deadweight tonnage and 25-foot draught as a maximum, and the committee in its report recommended reinforced ships of 5,0[illegible] 10,[illegible] tons deadweight capacity as being economical grain carriers. Nelson harbour is designed for boats drawing 23-24 feet of water. A 3000 ton vessel could carry about 100,000 bushels of wheat. Most ocean going craft now being built run between 5,000-7,000 tons gross register, are about 400 feet long and draw 26 feet of water.

Rates of insurance in commercial vessels on this route will doubtless be high till such time as sufficient statistics can be secured to satisfy the insurance companies that risks are not abnormal. Government boats operating on this route in 1914 were asked to pay 11% on the voyage as a premium. As a result they carried no insurance and 38 vessels made the voyage successfully and with no losses.

Harbour Facilities

The only harbour facilities on the west coast suitable for railway terminals are the natural facilities of Churchill and the partially constructed harbour at Port Nelson.

Churchill harbour is completely landlocked by rocky points and consists of a relatively small lagoon 30-40 feet deep with ½ square mile in which ocean going vessels can anchor and a larger basin 3 miles long and one to two miles wide, shallow and with a bottom of hardpan filled with boulders. The channel approach is short and 2,000 feet wide, well indicated and with a depth of 60 to 100 feet at the harbours entrance. The current is 5-6 miles per hour at ebb tide and the tide is uniformly 11-12 feet at its maximum, the harbour being approachable at all its stages, but is closed by ice cover 7 months of the year, from November 18th to June 19th on an average. The river freezes about a month earlier. There is good anchorage and a vessel of 24-foot draught can approach within 150 feet of the east side of the harbour. Dockage could be easily added.

The roadstead of the Nelson river has been partially converted into an artificial harbour by the engineers of the railway. It is a V-shaped estuary with a long and twisty approach 1,200-3,000 feet wide, 17-20 feet deep at low water and 20 miles long and with natural exposed anchorage available some distance from the post. The harbour works consist of a 17-span bridge 3,500 feet long leading from the shore to an artificial island paralleling the channel. The island is built of filled timber cribs with docks. The anchorage will be 30 feet deep at low water and 50 at high water with a width of 300 feet. Tides range between 8 and 20 feet, average spring tides being 16 feet.

Floating ice, driven by tides and winds across the flats, will carry away buoys during August and after the 18th of October. Solid ice cover breaks up about June 1st. The estuary is open half of the year, and Dr. Robt. Bell of the Geological Survey reported that during the winter of 1879-80 it did not freeze across for some 40 miles above tide water. Vessels approaching the harbour get in touch by wireless and pick up their pilot 20 miles out from the inner anchorage. They can only enter the harbour at high tide and in severe weather are obliged to remain at sea.

While Hudson bay is not entirely frozen over during winter ice-cover is formed for 60 or 70 miles from the shores on the east coast often constituting a bridge between the islands and the mainland, and in other parts of the bay, where the shores are flat, solid ice extends to sea for from one to five miles.

Advantages of Routes

With rail connection to Port Nelson and boats travelling between Port Nelson and Liverpool certain parts of the west would be given the advantage of a shorter and less broken haul to Europe. In round figures for certain districts this saving is: Regina 1,050 miles, Calgary 1,150 miles, Saskatoon 1,175 miles, Prince Albert 1,300 miles, Melfort 1,300 miles, Edmonton 1,250 miles, much of which is in rail haul. The route seems especially attractive for live stock shipments due to the shorter rail haul, and it is hoped that fall wheat could be placed on the Atlantic during September and October of the same year. The distance from Port Nelson to Liverpool is 2,966 miles, and from Montreal via Belle Isle 2,767 miles and via St.Johns 3,097 miles. Return cargoes while obviously an uncertain quantity would no doubt be a direct development of increased buying powers in the west.

A new route is also furnished between England and eastern Asia, which via Suez is about 16,000 miles, via New York and San Francisco about 11,000 miles and via Port Nelson and Prince Rupert less than 8,000 miles.

Hudson Bay Railway

The Hudson Bay railway, which connects at The Pas with the Canadian National Railway branch from the Winnipeg-Prince Albert line, is completed for 332 miles from The Pas to its second crossing of the Nelson river at Kettle rapids where a bridge has been built, leaving 92 miles of additional construction to complete the road, on which grading has already been done. The end of steel is 30 miles from the head of river navigation. Construction costs to date are approximately twenty million dollars including the work commenced at Port Nelson, amounting to over six millions. The principal expenses still to be undertaken to make this an operating route are: costs of completed ocean terminals, elevators, aids to navigation, etc., laying of steel for 92 miles, general physical rehabilitation of the road and purchase of rolling stock.

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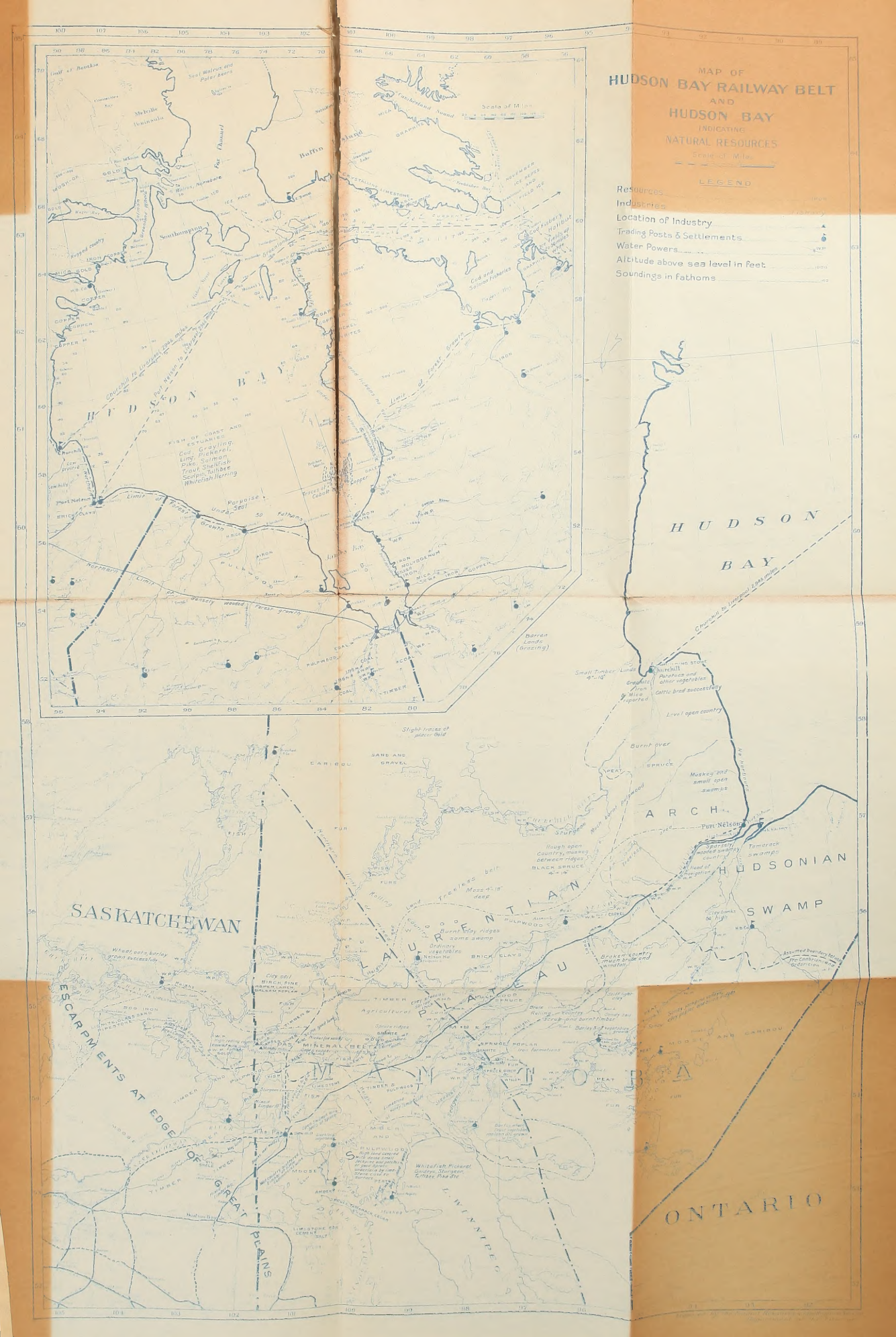
MAP OF
HUDSON BAY RAILWAY BELT
AND
HUDSON BAY
INDICATING
NATURAL RESOURCES
Scale of Miles
LEGEND
Resources
Industries
Location of Industry
Trading Posts & Settlements
Water Powers
Altitude above sea level in feet
Soundings in fathoms
HUDSON BAY
HUDSON BAY
Port Nelson
Churchill
Churchill to Liverpool 2,444 miles
Limit of Forest Growth
Barren Lands (Grazing)
Limit of Valuable Forest growth
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